LX.—*On* Halisarca lobularis, *Schmidt, off the South Coast of Devon, with Observations on the Relationship of the* Sponges *to the* Ascidians, *and Hints for Microscopy.* By H. J. Carter, F.R.S. &c.

Referring to my account of *Halisarca Dujardinii* given in the number of the 'Annals' for April, 1874, p. 315, I (taking advantage of the low tide on the 17th April) again visited the "rocks" here, for the purpose, if possible, of finding out the habitat of this sponge, and, when the tide was at its lowest ebb, observed it plentifully on short bits of *Chondrus crispus* and other small flat-fronded seaweeds of the same kind. But it may grow here and there on almost any and every thing, even to the bare rock itself, although, to the best of my knowledge, never anywhere where it is likely to be uncovered long by the sea-water.

In his 'Adriatic Sponges' of 1862, p. 80, Schmidt states, with reference to what Johnston said in England of this sponge, and Lieberkühn in Heligoland, that it was "white" (*weiss*). But if we are to take as "white" sponges *Grantia nivea* and the like, which look like so much snow, then the term "white" is not applicable to *Halisarca Dujardinii*.

Dujardin, who found it on the coast of Normandy and first described it, uses the term "blanchâtre;" Johnston, who found it on the coast of Northumberland, called it "straw- or ochre-yellow-coloured, mottled;" and Lieberkühn, who studied it in Heligoland, uses the words "weisslich grau;" while my own observations in this respect accord with those of Johnston, to which it might be added that when transferred to spirit and water, it becomes opaque and more yellow from the coagulating power of the alcohol over the translucent albumen of which the sponge is chiefly composed.

While engaged in looking after the habitat of *Halisarca Dujardinii*, I observed a pinkish lobulated substance growing on the rock amongst as well as over other sponges, and, having knocked off the bit of rock on which it was growing, without much injuring the sponge itself, put the whole into sea-water immediately, and thus took it home; where on closer examination I found it to be a specimen of Schmidt's *Halisarca lobularis*, of the Adriatic Sea, hitherto, I think, not enumerated among the sponges of the British coasts.

The diagnosis of this sponge given in Latin by Schmidt (*l. c.*) is short and conclusive, viz.:—"*Halisarca* obscure violacea irregulariter plicata et lobata."

On the following day I fed this specimen of *Halisarca lobularis* with indigo; and although it only took in this par-

tially, so as to become deeply coloured here and there, it was quite sufficient for me to be able to distinguish the spongozoa from the other parts of the structure &c., as will be seen hereafter. Meanwhile, as Schmidt's description is rather meagre, and the sponge would appear not to have been noticed on our coasts before, it may not be unacceptable to some to have the following description of the specimen that I have just found on the south coast of Devon.

Halisarca lobularis, Schmidt.

General form.—Sponge lobate, consisting of irregularly lobed ridges about a line high, extending themselves in branched digitations over the rock and adjoining sponges. Lobes ficoid, agglomerated, divided into minute lobuli with angular pits or intervals between them where they cannot, from their rounded form, come into contact. Surface smooth, sleek, and of a pink colour on the prominent portions, passing into light brown-yellow below. Vents sparse, situated here and there on the lobes, not raised above the surface, and sufficiently large to be visible to the naked eye. Pores minute and numerous, each consisting of a round aperture situated in the centre of a papilliform ring—which rings being in juxtaposition, thus form the dermal surface of the lobule.

Internal structure composed of spongozoa, aggregated into sac-like forms of various shapes and sizes, some of which are distinctly conical elongate, and have their narrow ends respectively in connexion with a canal leading inwards from the pore, imbedded in a kind of trama consisting of sarcode (filamentous ?) and granuliferous cells, but with their confines neatly defined by a translucent linear interval; also of pore-canals forming a network extending inwards from the surface, and of a branched system of excretory canals terminating in the vents. No spicules of any kind, but here and there small globular masses of minute uniform granules possessing a nucleus (nuclear utricle), and small spherical opaque nucleus (nucleolus), with germinal spot or vesicle, no doubt ova. Pink colour confined to the spongozoa in the prominent parts of the lobes, whereby their sac-like aggregations here become more distinctly differentiated.

Size of specimen about 1½ inch long by 1 inch wide and 1 line high. Pores of the specimen in spirit 1-1660th inch in diameter; papilliform circles surrounding them from 1½–2-830ths inch in diameter. Vents variable in size, but large enough to be seen by the unassisted eye.

Hab. New Red Sandstone rocks, lower surface; between tides.

Loc. South coast of Devon, Budleigh-Salterton.

Obs. This specimen of *Halisarca lobularis*, of which the type was originally found by Schmidt in the Adriatic Sea at Subanico, does not differ from his description in any essential point. The pink colour on the prominent parts (stated by Schmidt to be "dark violet" in the Adriatic) goes very soon after immersion in spirit and water, where its original translucence is replaced by whitish yellow opacity.

The deep triangular puncta or interspaces between the lobules appear to be caused in the way above mentioned, and therefore lead to nothing; while the surface of the lobules is formed of the papilliform openings of the pores, which are far too small to be seen with the naked eye, or even any thing below an inch compound power.

The most remarkable points about the pink colour are:—first, that it is exclusively confined to the spongozoa, whereby it would appear that the colour of sponges generally is seated in the spongozoa, as in *Halisarca lobularis*; and, second, that by this pink colour in the living state the form of the sac-like aggregations of the spongozoa can be as distinctly seen as if the latter had been fed with indigo. Lower down, however, the absence of the pink colour renders this differentiation less evident; while the presence of the indigo here, after the sponge has been fed with it, causes the differentiation to be more striking even than in the pink portions, where the latter colour somewhat obscures it.

Halisarca lobularis differs from *H. Dujardinii* in the following particulars, viz.:—*H. lobularis*, in the fresh state, is lobed and lobulated, tinted pink on the prominent parts, sleek on the surface, and provided with sparse vents on a *level* with the surface. *H. Dujardinii*, on the other hand, in the living state, is uniformly flat and even, of a yellowish grey colour, sleek on the surface, and sparsely provided with vents, which are projected *above the level* of the sponge by a short tubular prolongation of the dermal sarcode. Both may be charged with ova after the manner of sponges generally, as some specimens of the latter from the Isle of Man (lately sent to me by my friend Mr. Higgin, of Liverpool) testify.

Having already found two specimens of *H. lobularis*, and knowing now what to look for, viz. a pink colour, lobulated form, and sleek shining surface, I dare to say that I shall often meet with it.

Of course Schmidt's diagnosis of *Halisarca*, viz. that it possesses neither siliceous nor calcareous spicules, obtains with *Halisarca lobularis*.

Ampullaceous Sacs and Spongozoa.
(Häckel's "Gastrula" when developed *in situ*?)

In the 'Annals' of 1857, vol. xx. p. 21, I published a description of the "Ultimate Structure of *Spongilla*," which appears to me, so far, to be typical of every other sponge, both marine and freshwater, that I have examined.

It was there that I first described and figured the "ampullaceous sac," after having fed the *Spongilla* with carmine, and showed that this sac was composed of a pavement-layer of monociliated cells (spongozoa) with a distinct and common aperture; also that each spongozoon took in fragments of carmine, while its cilium might be seen to vibrate in the cavity of the ampullaceous sac (*l. c.* pl. 1. fig. 5, &c.). The terms "sac" and "cell" involve the idea of a sac- and cell-wall respectively, which here must be maintained on inference rather than demonstration. There must be a "vanishing-point" in early development; and to assume that a tissue cannot exist in such a subtile state as not to be appreciable by our senses, seems to me to be an untenable position. In this sense, therefore, I use the terms "sac" and "cell" for these sarcodal bodies respectively.

At p. 28 (*l. c.*) it is stated (with reference to the undigested portions) that, "after a certain time, the particles of carmine which have accumulated round the inner surface of the sac are gradually thrown off from its circumference, and falling into the efferent system of canals, are thus carried away and finally ejected." It will be for us to consider, by-and-by, whether this takes place through the pavement-layer of the spongozoa *generally*, or at *one* particular point of the sac.

Lastly, in the 'Annals' of 1873, vol. xii., in my paper on the Gummineæ, it is stated at p. 27:—"I cannot help thinking that there are more species than *Halisarca Dujardinii* to be found on our coasts; so I hope to meet with not only this, but other species of the family here in a living state, through which I may, by experiment, be able to add something more satisfactory to our knowledge of their intimate structure than we at present possess."

My anticipation in this respect will have been seen to have been realized in the discovery of *Halisarca Dujardinii* and *H. lobularis* on this coast; while it so happens that by having fed the latter with indigo, still more precise information of the nature of the ampullaceous sac has been obtained.

By the above description of *H. lobularis* it will also have been seen that the ampullaceous sac is not only rendered more distinct by the presence of the indigo in the spongozoa,

but that it is rendered almost equally so in the most prominent parts by the pink colour of the spongozoa in the living condition of the sponge. Hence we have thus a distinct organ presented to us for consideration, viz. the ampullaceous sac.

And first, as regards its form in *H. lobularis*, this is irregularly round, but, in many instances, distinctly conical elongate; for all these sacs are neatly defined, as before stated, by a translucent linear interval, which may thus be compared to the crystalline calcspar that surrounds the brecciated fragments of a marble rock. To this translucent linear interval we shall return presently.

Meanwhile, taking the "conical elongate" sac, we thus have a fundus and a neck. The former, from its rounded contour, is clearly defined by the translucent linear interval; while the latter, from the presence of the indigo, shows (where the sac is close to the surface) that it is in direct continuation with the pore by a short tubular prolongation.

Further, it might be observed that the pore-canals branch off internally so as to form a reticulation, which, following the translucent linear intervals just mentioned, thus reaches the *oral* apertures, as they may be termed, of the more deep-seated ampullaceous sacs respectively.

From the pore on the surface to the ampullaceous sac we can thus trace the indigo and thence into the bodies of the spongozoa. And that the spongozoa are the only bodies which take in the indigo, may be inferred from its *absence* in all other bodies or cells of a like kind in the structure of the sponge.

Here the indigo remains, and hence the easiness with which we can make the demonstration. Not so, however, when the undigested portions are transferred to the excretory canal; for here they are *instantly* discharged. Hence the difficulty of following their course from the interior of the ampullaceous sac to the excretory canal. In *Spongilla*, as before stated, I have seen this take place, but have never yet been able to pronounce whether the undigested particles of colouring-matter are transferred through the pavement-layer of spongozoa *generally* or at *one* specialized point of the ampullaceous sac.

If the former, it necessitates our assuming that the whole of the ampullaceous sac up to its neck is enclosed in a dilated extremity of a branch of the excretory canal-system; if the latter, that there is a specialized point in the ampullaceous sac, tantamount to an *anal* orifice, continuous with the branch of the excretory canal.

I incline to the latter, as being the most probable conjecture;

and if right, then we see the resemblance of the ampullaceous sac to the Ascidian, more especially of the compound Tunicata, in so far that each has an *oral* and an *anal* aperture.

"Very good," it may be stated; "but what have you in the Ascidian to compare to your individualized spongozoa, each of which appears to be a distinct animal?"

In reply to this I would observe that if among the compound Tunicata (which, being of the same habitat as *Halisarca*, grow plentifully together) we select a species that, by its translucence, permits of the young or embryonal Ascidians of the group being viewed under a microscope throughout their development, we may see that, at one stage, the young Ascidian is almost identical in appearance with the ampullaceous sac—that is, that it is composed of a pavement of cells aggregated into a sac-like form. Finally the internal organs of the Ascidian are developed, and the sac acquires an oral and an anal aperture. But in the sponge—that is, in *Halisarca* (as we are now more particularly engaged with this sponge)—the cells of the pavement-layer pass into individualized animals, each of which takes in its proper nutriment, and probably possesses individually or conjointly its proper generative function; for to assume that they do not possess the latter would be to assume that the isolated forms described and figured by the late Prof. James-Clark ('Annals,' 1868, vol. i. p. 133, pl. v.) do not possess this power.

Thus the development of the ampullaceous sac is arrested, and the cells adapt themselves to that condition which ends in the evolution of a sponge; while the sac and its cells in the development of the Ascidian go on to the evolution of a compound tunicated group.

To make this more intelligible it might be stated that if, by the theory of evolution, the monad passes up to man, the monadine cell could not, at the time of reproduction, have been identical with the human ovum, because it must have possessed specialized powers of self-nutrition and immediate generation.

At the same time the differentiation that takes place in the evolution of the variously formed cells composing respectively the organs of the human body, from the simple cell-form of the human ovum, points out differences almost as great if not as numerous as those in the animals between man and the monad.

Hence we see that an organic cell may be at one time one thing and at another another, arising simply from adaptation to the functions required. Thus the cell or spongozoon of the ampullaceous sac becomes an individualized animal,

and the *whole* sac, with its oral and anal apertures, so far like an Ascidian; while the sac with its pavement-lining of cells in the compound tunicated animal goes on unarrested to produce an Ascidian. It is on this account that I have stated that there is a greater relation between the Sponges and the Ascidians than between the Sponges and the Corals, whose polypes have but one aperture for both purposes.

To produce the "adaptation" there must be, of course, a creative or directing power, which, being *infinite*, we can never comprehend.

I would here add, for the information of those who care to experimentalize on the living sponges by feeding them with indigo or carmine (magenta will not do, for it dyes *all* alike), that the portion of sponge must be taken from its habitat without injury, put in sea-water directly, kept there until the following day (forenoon); the water then changed, and the indigo or carmine added by having been rubbed off a cake of one or other of these substances in sea-water, and dropped upon the sponges, where it should be allowed to remain about an hour, always remembering that the experiment will be unsuccessful if it be not previously ascertained, by the ejection of particles from the vents (which can be seen under a 1-inch compound power), that the sponge is living and *active*. Portions may then be examined microscopically, after which the sponge should be placed in spirit and water for doing this at convenience.

A priori it might be considered desirable to have the sponge as fresh as possible; but experiment has taught me otherwise, viz. that to get the cilia retained with the indigo still in the body of the spongozoon, the sponge should be kept for a day first, in the way above stated, whereby, being weakened and hungry perhaps, the experiment is more likely to succeed.

Then, of course, the best plan is to examine a portion while the sponge is yet *alive*; after which it may be placed, as above noticed, in spirit and water for more deliberate observation. In this state, too, a portion may be torn to pieces on the slide, dried and mounted in balsam, when, in many instances, the general form of the body and cilium will still be retained; or the fragments may be dyed with magenta, when the cilium will become still more evident; but, of course, what will render the transparent sarcode visible, will be likely to obscure the particles of indigo. Lastly a fragment having been torn to pieces on the slide in water, it may be *simply* dried, when the cilium will become more evident than in the wet state.

In examining minute objects, it is very desirable to acquire the power of holding a lens with the eye after the manner of a watchmaker; this, besides giving as it were a third hand, enables the operator, by means of a very high power, to pick out objects from material spread over the slide, through the aid of a subjacent mirror or black ground, and thus turn them over and over so as to obtain a view, under a compound power, of all parts of the object, such as it might be difficult, if not impossible, to get under any other circumstances.

Again, the microscopist should also endeavour, when he has got the focus of the "fine adjustment," to render it still finer by gently pressing down the tube, whose resiliency, up and down, will thus give the observer a better idea of a minute object than any other means. Indeed it is absolutely necessary with *very* minute objects.

LXI.—*A Revision of the Genera* Epicharis, Centris, Eulema, *and* Euglossa, *belonging to the Family* Apidæ, *Section* Scopulipedes. By Frederick Smith, Assistant in the Zoological Department of the British Museum.

[Concluded from p. 373.]

Section Corbiculipedes.

Genus Eulema, St.-Farg.

Generic Characters.

Head narrower than the thorax; the clypeus produced anteriorly; the labrum subquadrate, convex, its anterior margin slightly curved; mandibles subdentate, having on their inner margin three blunt teeth; the tongue elongate, nearly as long as the body: the maxillary palpi two-jointed, the first joint shorter than the second, its apex truncate; the second joint twice the length of the basal one, pear-shaped, and with a long stiff bristle near its apex: the labial palpi elongate, setiform, two-jointed, the division of the joints obscure. *Thorax*: wings with one elongate marginal cell and three submarginal cells, the first and second of nearly equal length, the third as long as the first and second united; the first recurrent nervure received by the second submarginal cell near its apex, the second recurrent uniting with the third transverse nervure. The posterior tibiæ of the females much flattened, concave exteriorly: in the male the tibiæ are convex, and concave above, two thirds of their length from their apex towards their base.